

***Peristenus relictus (stygius)* (Hymenoptera: Braconidae)
A Possible Biological Control Agent
For Tarnished Plant Bug, *Lygus lineolaris*, (Hemiptera: Miridae)
In New Jersey**

**Annual Report
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Introduction

Tarnished plant bug, (TPB), *Lygus lineolaris*, (Hemiptera: Miridae) (Figure 1) is a piercing sucking insect native to North America that feeds on over 300 plant species and causes at least two billion dollars in losses and control costs each year (Day 2002). Adults over-winter under leaf litter and become active during the first warm days of spring. Mating and oviposition occur within days and females lay 30 to 120 eggs during their lifespan. Eggs hatch within 10 – 12 days with life cycle completion in 3 to 4 weeks. Generally, there are 3 generations per year in New Jersey (Chianese 2001).



Figure 1. Tarnished plant bugs in rearing box.

The tarnished plant bug is widely distributed, and can be found in all states east of the Rocky Mountains where it is a pest of many agricultural crops including vegetables, fruits and seed crops (Schwartz and Footit 1998). Damage to these crops frequently goes unrecognized because there are no visible signs of TPB feeding. Crop damage is not obvious until weeks after feeding has occurred (Day 2002). Generally, the damage causes a reduction in yield due to a severe distortion of fruit or plant terminals. Growers routinely use broad-spectrum insecticides as a prophylactic treatment on high value crops; however, these spray treatments may cause secondary pest problems by reducing beneficial insect populations that keep minor agricultural pests at tolerable levels.

In early spring, the majority of TPB damage is found on fruit trees, which is caused by the reservoir of TPB found in the annual weeds in bloom at that time. The TPB feed on these weeds and as the weeds die or senesce, they move up onto the developing buds, where they lay eggs on the flower buds, blossoms and young fruit (PSU 2000). Damaged flower clusters appear dried and the leaves appear distorted. The damage to the fruit is the primary concern, because it can cause punctures or deep dimples to form as the fruit develops, resulting in deformities known as “cat facing” (Spangler et. al. 1991). In New Jersey, the TPB and other “cat facing” insects are the single largest cause for insect fruit damage in peaches statewide and over most varieties” according to Rutgers Cooperative Extension Fruit IPM coordinator Dean Polk (Chianese 2001).

The TPB has a number of natural enemies such as other true bugs (nabids, geocorids), ladybird beetles, spiders and parasitic wasps, but they are not able to control the pest effectively (Spangler et. al. 1991). In an attempt to reduce indigenous TPB populations, the United States Department of Agriculture – Agriculture Research Service (USDA-ARS) introduced two species of European parasitoids, *Peristenus digoneutis* and *Peristenus relictus* (Hymenoptera: Braconidae) previously known as *Peristenus stygicus*

(Figure 2). These multivoltine species have been found to parasitize significant numbers of TPB nymphs in certain forage crops and strawberries. In addition, *P. digoneutis* has also been shown to reduce “cat facing” damage to apples in New Hampshire by 63% (Day 2002).

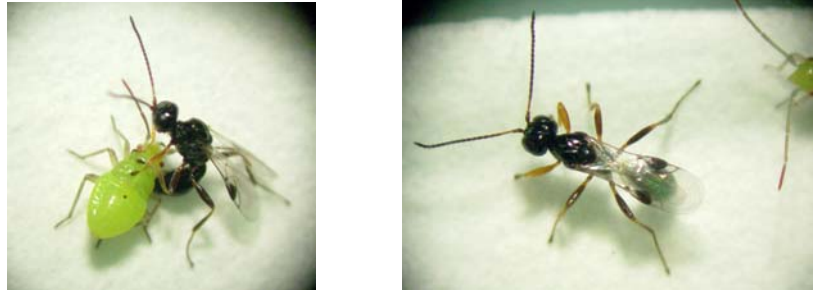


Figure 2. *P. relictus* attacking tarnished plant bug nymph (L) and adult female (R).

P. digoneutis is native to Northern Europe and was released in New Jersey in the early 1980's by Dr. William Day of USDA-ARS. It has become well established in Northwestern New Jersey, and had not been recovered south of Hunterdon County in Northern NJ until it was recovered in 2003 in small numbers in Gloucester County by the New Jersey Department of Agriculture. It was speculated that the Southern New Jersey climate was not conducive to the establishment of *P. digoneutis*, which resides in a more northerly climate in Europe. This resulted in the introduction of a second species, *P. relictus*, a close European relative of *P. digoneutis*. *P. relictus* was imported from Southern Europe where the climatic match is similar to that found in Central and Southern NJ, the regions of NJ where most of the high cash crops such as peaches, apples and strawberries are grown.

In 2001 the New Jersey Department of Agriculture's, Phillip Alampi Beneficial Insect Laboratory (NJDA-PABIL) entered into a pilot agreement with and received funding from the United States Environmental Protection Agency (USEPA) to mass produce and release *P. relictus* in Southern and Central NJ. The objective was to establish *P. relictus*, reduce TPB populations in alfalfa, and potentially introduce the parasite (via dispersal) into orchards and other high value crops (Chianese 2001).

Materials and Methods

In the fall of 2000, field staff from PABIL, using standard insect sweep nets, surveyed alfalfa, hay and fallow fields to locate populations of TPB. The data collected during the sweep surveys resulted in a list of possible locations for trial releases. Additional data collected from the surveys was used to establish baseline information for TPB populations and the presence of native parasitoids.

The original 2001 Whig Lane and subsequent 2002/2003 Cedar Road release sites for *P. relictus* were in Gloucester County alfalfa fields surrounded by and in close proximity to both apple and peach orchards. Alfalfa was chosen because it is a perennial plant that is grown in fields that are not cultivated yearly and it is a host for the TPB. The alfalfa

stand remains in the same field for some years, the TPB only causes minor damage in alfalfa, it is seldom treated with insecticides, and the TPB and parasite population can be preserved. The grower's alfalfa management practices at the release sites made them ideal for our purposes because the fields were harvested in strips staggered throughout the growing season. This harvesting practice keeps the TPB in the field, thus providing a continuous supply of TPB nymphs for *P. relictus* to parasitize. This enables the parasitoid to build up its numbers within the release area, before it dispersed into the surrounding strips.

The uncut strips in the release field were sampled weekly using standard insect sweep nets (Figure 3). Population samples of TPB consisted of 100 sweeps. The collection was then placed into a sleeve cage (Figure 4) and the number of TPB adults and nymphs was recorded. If there were not 75-100 nymphs in the first 100-sweep sample, then the field was continually swept until a total of 75-100 nymphs were collected. The nymphs were then taken to PABIL, where they were held for parasite recovery.



Figure 3. Sweeping for TPB



Figure 4. Sleeve cage

In 2004, two additional release sites were set up, one in Mantua Township, Gloucester County and the other at the Rutgers Research Farm in Upper Deerfield Township, Cumberland County. The same sampling procedures used for 2001-2003 release fields were followed for the two new sites. Both new sites were on set-aside or fallow ground with high weed populations and the predominant weed being mare's tail, *Conyza canadensis* (Asteracea). Preliminary field studies in 2000 found high TPB populations in weedy locations. These weedy fields were also less susceptible to disruption by normal harvesting and cultivating practices.

Three new sites added during the 2005 season. These were established in alfalfa fields, one in Vineland, Cumberland County and two in Mannington, Salem County. There were also two procedural changes instituted. First, the 2004 Cumberland County site at Rutgers Centerton Farm was strip planted with wild flowers in order to draw in more TPB and provide a more diverse weed population. The second change involved release protocols. In the past, all parasitoids reared during the season went into that season's study sites (Table 1). In 2005 due to a new artificial diet rearing technique, PABIL laboratory staff was able to produce significantly more *P. relictus* than previous years. The result was *P. relictus* release numbers reached the goals set for the study sites by late August so subsequent releases were made in areas that were some distance away from the study sites in order to attempt to establish *P. relictus* over a wider geographic area.

In 2006, PABIL entered into a cooperative agreement with the USDA-ARS and Delaware State University to produce, release and monitor *P. relictus* in Delaware and New Jersey. Under the terms of the agreement PABIL would provide parasitized *L. lineolaris* nymphs and adult *P. relictus* for New Jersey and Delaware. There were six alfalfa study sites consisting of two *P. relictus* adult release sites, two parasitized TPB nymph release sites and two control sites in each state. Delaware cooperators were responsible for processing of weekly nymph collections they received from both states, as well as rearing and dissecting a portion of the collections. The total for the release sites is in Table 1.

Table 1. *Peristenus relictus* Releases in New Jersey

County	Location (Township & Road)	Release Year	Dates	Number Released	Total
Gloucester	Elk, Whig Lane *	2001	7/27-8/24	250	250
Gloucester	Elk, Whig Lane	2002	6/14-9/25	1,650	1,650
Gloucester	East Greenwich, Cedar Road *	2003	8/1-10/30	930	930
Gloucester	Mantua, Jackson Road	2004	7/2-9/30	1,750	3,400
Cumberland	Upper Deerfield, Polk Lane *	2004	7/23-9/17	1,650	
Cumberland	Vineland, Maple Avenue *	2005	6/21-8/23	4,750	18,625
Salem	Mannington, Acton Station Road *	2005	6/24-8/29	5,125	
Salem	Mannington, Rt. 45 Acton Sta. Rd. *	2005	6/24-8/19	3,625	
Atlantic	Buena Vista, Brewster Road	2005	9/2-9/9	1,375	
Salem	Upper Pittsgrove, Burl.-Shirley Rd.	2005	9/9	500	
Salem	Pittsgrove, Daretown-Aldine Rd.	2005	9/23	750	
Salem	Oldmans, Pennsville-Pedricktown Rd.	2005	9/30	750	
Salem	Elsinboro, Mason Point Road	2005	10/7	500	
Cumberland	Stow Creek, Causeway Rd. & Stow Creek Rd.	2005	9/16	750	
Cumberland	Fairfield, Rahmah & Cedarville Road	2005	10/14	500	
Gloucester	USDA-Harrison, Bishop Rd. * PN	2006	6/30-8/25	3000	21,500
Gloucester	USDA-Woolwich, Davidson Rd. * PN	2006	6/30-9/22	5000	
Salem	USDA-Lower Alloways Ck, Beasley Neck Rd.*	2006	6/30-9/01	1750	
Salem	USDA-Upper Pittsgrove, Daretown Lake *	2006	6/30-9/22	2750	
Cumberland	Upper Deerfield, Friesburg Road 4 Fields	2006	6/8-10/13	3000	
Mercer	Hopewell, Honey Brook Organic	2006	5/25	500	
Salem	Upper Pittsgrove, Route 581	2006	7/5	500	
Cumberland	Downe, Route 734 and 637	2006	7/7	1000	
Cumberland	Upper Deerfield, Tice Lane	2006	11/1	1000	
Cumberland	Hopewell, Trench Road	2006	11/1	500	
Cumberland	Upper Deerfield, Griens Lane and Burlington Rd	2006	6/23	500	
Cumberland	Hopewell, Barretts Run	2006	6/16-10/20	1000	
Cumberland	Hopewell, Beals Mill Road	2006	6/20-10/13	1000	
Total	28 Locations				46,355

* 2006 collection fields, PN = parasitized nymphs

Results and Discussion

Weekly surveys and collections in the 2006 TPB program began in June and continued through October. The Gloucester County fields (Whig Lane and Cedar Rd) were each sampled 13 times. Nymphs first appeared in mid- June with their peak population occurring in early to mid-July. Eight weekly nymphal collections were made at each of these two sites and sent to the laboratory for processing between 7/12/06 and 10/10/06 for recovery of parasitoids. A total of 28 Braconids were recovered; 20 were identified as the native species, *Leiophron uniformis*, and 8 were *Peristenus* spp.

The Salem County field (Acton Station Rd) and the two Cumberland County fields (Polk Lane and Maple Ave) were each surveyed 11 times. A total of nine collections were made from the three sites from 7/24/06 and 10/03/06. Nine Braconids were recovered from the collections; 8 were the native species, *Leiophron uniformis*, and 1 was a *Peristenus* sp.

The *Peristenus* specimens collected from all locations were sent to the USDA-ARS BIRL in Newark, DE for species confirmation. Table 2 shows the site location and the year of *Peristenus* recoveries. The initial recovery of a female *P. relictus* from a 2004 release site (Polk Lane, Rutgers) was a major highlight. However, since this is the first and only specimen that has been recovered so far, it is too soon to consider *P. relictus* as being established until more are recovered in succeeding years. The recovery of *P. digoneutis* for the third consecutive year at multiple locations, on the other hand, is significant in that it demonstrates that its population has increased and has been able to establish in a more southerly region than was previously thought although the populations are low. The USDA-ARS BIRL staff also determined, through the dissections of New Jersey field collections, that the present rate of parasitism of *P. digoneutis* in Southern Jersey is 4.71%. This rate is well below the 30% or more that is found in Northern New Jersey (Day et al. 2003). This rate of parasitism may increase over time as population levels of *P. digoneutis* continue to increase. However, the rate is still low and may indicate that *P. digoneutis* is not as suitable as a climatic match to southern New Jersey because the parasitoid had been released in Gloucester County in the 1980's (Day, et. al. 2000) and has had nearly twenty years to build its population.

Table 2. Location and Year of Recovery of *Peristenus* Species

County	Location	2004 # of <i>Peristenus</i> species	2005 # of <i>Peristenus</i> species	2006 # of <i>Peristenus</i> species
Gloucester	Elk, Whig Lane	(1) <i>P. digoneutis</i>	(6) <i>P. digoneutis</i>	(8) <i>P. digoneutis</i>
Gloucester	East Greenwich, Cedar Road	(1) <i>P. digoneutis</i>	(6) <i>P. digoneutis</i>	
Cumberland	Upper Deerfield, Polk Lane			(1) <i>P. relictus</i>
Salem	Upper Pittsgrove, Daretown Road (USDA)			(1) <i>P. digoneutis</i>
Gloucester	Woolwich, Davidson Road (USDA)			(1) <i>P. digoneutis</i>

Conclusion

In 2006, the recovery of numerous *P. digoneutis* for the third consecutive year at multiple locations is significant in that it demonstrates that its population has increased and has been able to establish in a more southerly region than was previously thought. The major highlight of the season was the initial New Jersey recovery of the exotic parasitoid *P. relictus* from a 2004 release site. In time, *P. relictus* may become established and possibly with *P. digoneutis*, may reduce crop damage and economic losses in high value cash crops in southern New Jersey.

2007 Plans

The same protocol for surveys and collections will be used as in previous years. The 2004 release site where *P. relictus* was recovered in 2006 will be surveyed more frequently in order to enhance our chances of recovering more *P. relictus* in 2007. New release sites of *P. relictus* will be at least a ½-mile away from all other previous release sites to reduce the possibility of *P. relictus* adults moving into the new release sites. Releases will begin at the first appearance of nymphs and will continue weekly or biweekly throughout the growing season.

Photo credits: M. Mayer, NJDA, PABIL

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